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Lewis Research Center



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Computer Programs for the Design of Liquid-to-Liquid Jet Pumps

Computer programs have been developed based on the one-dimensional equations describing noncavitating and cavitating flow in liquid-to-liquid jet pumps. Five programs have been written. Essentially, each program simply operates on a specific combination of input parameters and provides a set of output parameters which enable a designer to choose a pump. There are five programs because there are five common design situations, each carrying a unique set of "known" parameters and requiring another set of output parameters to specify a design.

The programs may be used for any liquid for which the physical properties are known. Calculations for noncavitating and cavitating performance were combined, permitting a calculation of cavitation limits within the program. Design charts may be developed without the manual iteration which is common to existing design methods.

Program inputs consist of: pertinent pressure, flow, and geometric variables; estimated friction loss coefficients; and fluid properties. Outputs consist of: the basic jet pump nondimensional parameters; other pertinent pressure, flow, and geometric variables; and an indication of whether the flow is cavitating or noncavitating.

The five design programs have the following input and output elements:

- P_1 = Primary total inlet pressure
- P_2 = Secondary total inlet pressure
- P_D = Outlet total pressure
- W_1 = Primary fluid weight flow
- W_2 = Secondary fluid weight flow
- M = Flow Ratio, W_2/W_1
- A_n = Area of primary nozzle at nozzle exit plane
- A_t = Area of throat
- R = Area Ratio, A_n/A_t

Program I is one of the more versatile programs. It lends itself quite well to design chart development since P_1 and W_2 are the only inputs definitely required. The "varying input variables" (M , R , and P_2) may be selected at random to permit the effects of variation of each to be investigated; or, if they are known, the program may be run in a straightforward manner to produce only one set of output.

Program II is used when the throat diameter of a pump is known, either as a design constraint, or as part of an existing pump that is to be redesigned.

Program III is the one program that will most often be used in conjunction with some other program. It is used when a pump must be designed to operate quite close to the cavitation limit, and it identifies the cavitation-limited pump configurations.

Program IV is used when secondary flow rate W_2 and pump pressure rise, $P_D - P_2$ are known and when there is some flexibility in the choice of driving pressure P_1 or flow W_1 .

Program V is used when the jet pump geometry is completely specified and it is desired to know the off-design performance.

The programs are adaptable in use. Single-pass design-point calculations may be made if the design requirements are fully specified. Or, if some of the parameters are variable, one or more programs may be used to construct elaborate design charts.

Notes:

1. The equations for each program are followed by a sample design problem illustrating use of the program.
2. These programs are written in FORTRAN IV for use on the IBM-7094.
3. Inquiries concerning this program should be directed to:

(continued overleaf)

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